

**STANFORD INSTITUTE FOR ECONOMIC  
POLICY RESEARCH (SIEPR)**



Federal  
Communications  
Commission

# **REVERSE AUCTION ENGINEERING CONSTRAINTS**

**ROBERT D. WELLER**  
CHIEF, TECHNICAL ANALYSIS BRANCH

**ROBERT.WELLER @ FCC.GOV**

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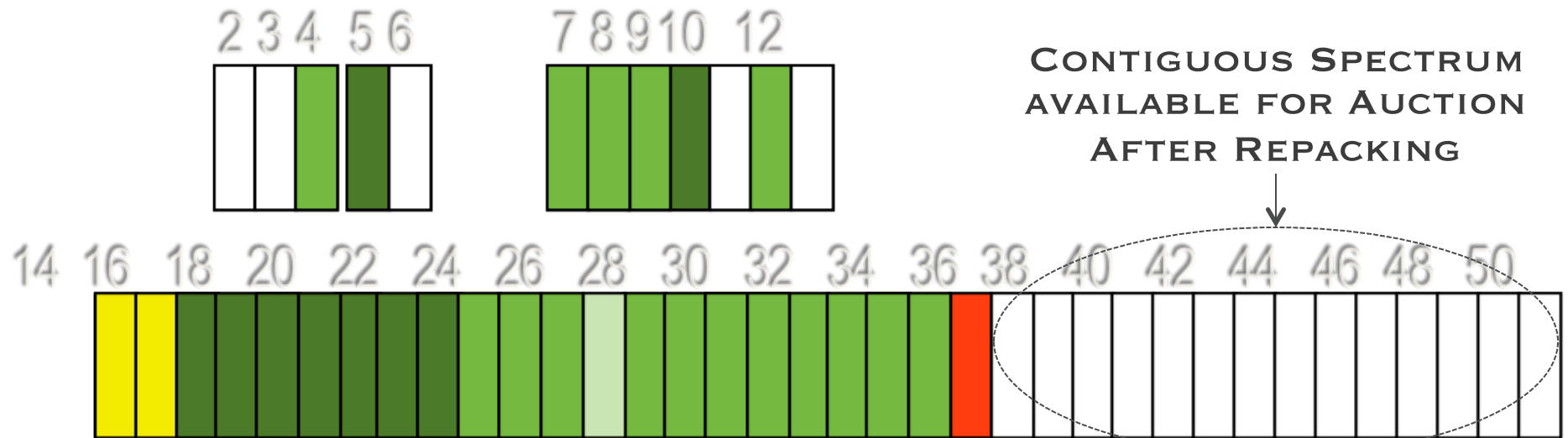
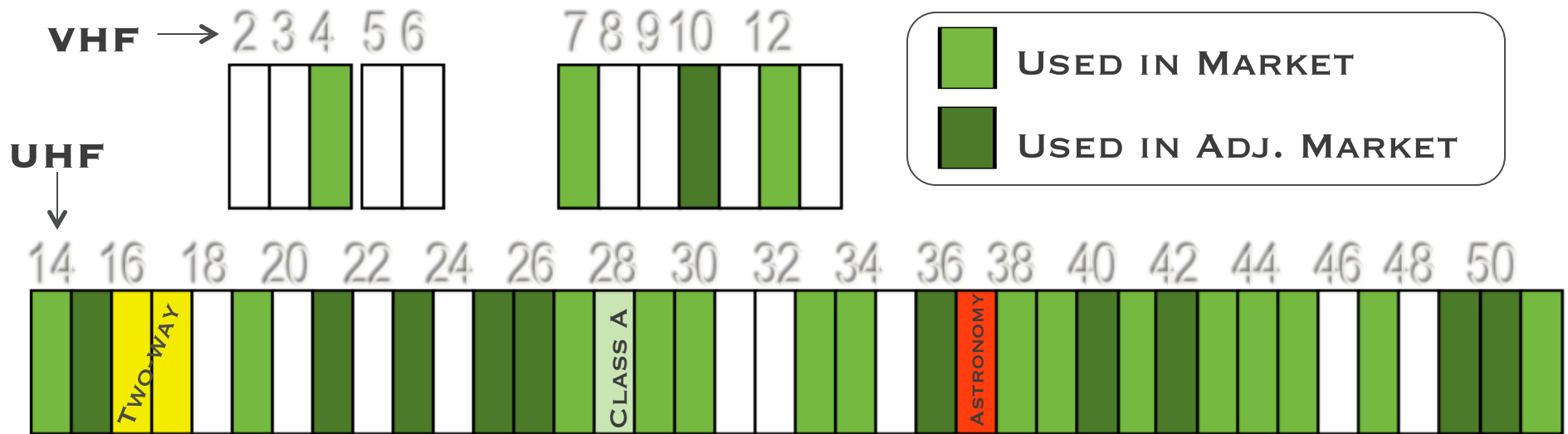


# **REVERSE AUCTION ENGINEERING CONSTRAINTS OVERVIEW**

- **TELEVISION SPECTRUM**
- **LEGISLATIVE MANDATES AND FCC GOALS FOR “REPACKING”**
- **FREQUENCY ALLOTMENT AND  
CHANNEL REUSE RESTRICTIONS (RF INTERFERENCE)**
- **WHAT IS OET-69?**
- **POSSIBLE DEFINITIONS FOR COVERAGE AREA AND  
POPULATION SERVED**
- **USING TRUTH TABLES FOR INTERFERENCE CALCULATIONS**



## TELEVISION SPECTRUM (ILLUSTRATION)





## LEGISLATIVE MANDATES AND FCC GOALS

- “THE COMMISSION SHALL MAKE ALL REASONABLE EFFORTS TO PRESERVE, AS OF [FEBRUARY 22, 2012], THE COVERAGE AREA AND POPULATION SERVED OF EACH BROADCAST TELEVISION LICENSEE, AS DETERMINED USING THE METHODOLOGY DESCRIBED IN OET BULLETIN 69”
- TRANSITION EXPEDITIOUSLY TO:
  - MINIMIZE VIEWER DISRUPTION
  - MAKE RECOVERED SPECTRUM AVAILABLE SOONER
- MINIMIZE CHANNEL CHANGE REQUESTS



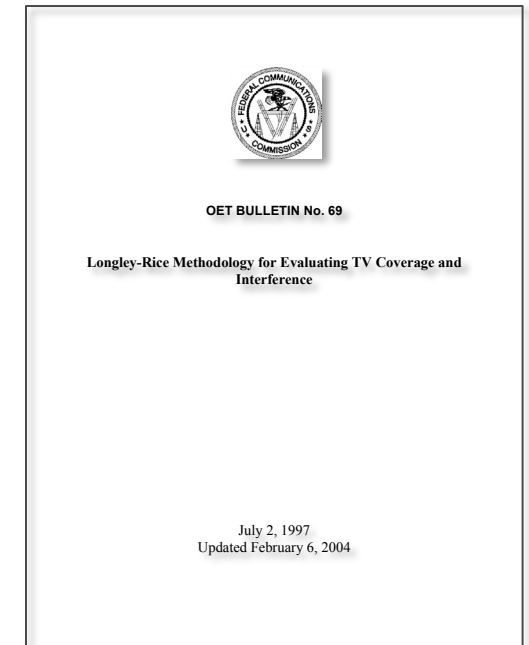
## CHANNEL USAGE RESTRICTIONS TO LIMIT INTERFERENCE

- CO-CHANNEL OPERATION GENERALLY REQUIRES PHYSICAL SEPARATION OF TRANSMITTING LOCATIONS
- ADJACENT-CHANNEL OPERATION GENERALLY REQUIRES EITHER PHYSICAL SEPARATION OR COLLOCATION
- OET-69 ACCOUNTS FOR LOCAL TERRAIN AND OTHER FACTORS, WHICH MEAN THAT THE ACTUAL DISTANCES REQUIRED TO PREVENT INTERFERENCE COULD BE GREATER OR LESSER



## WHAT IS OET-69 ?

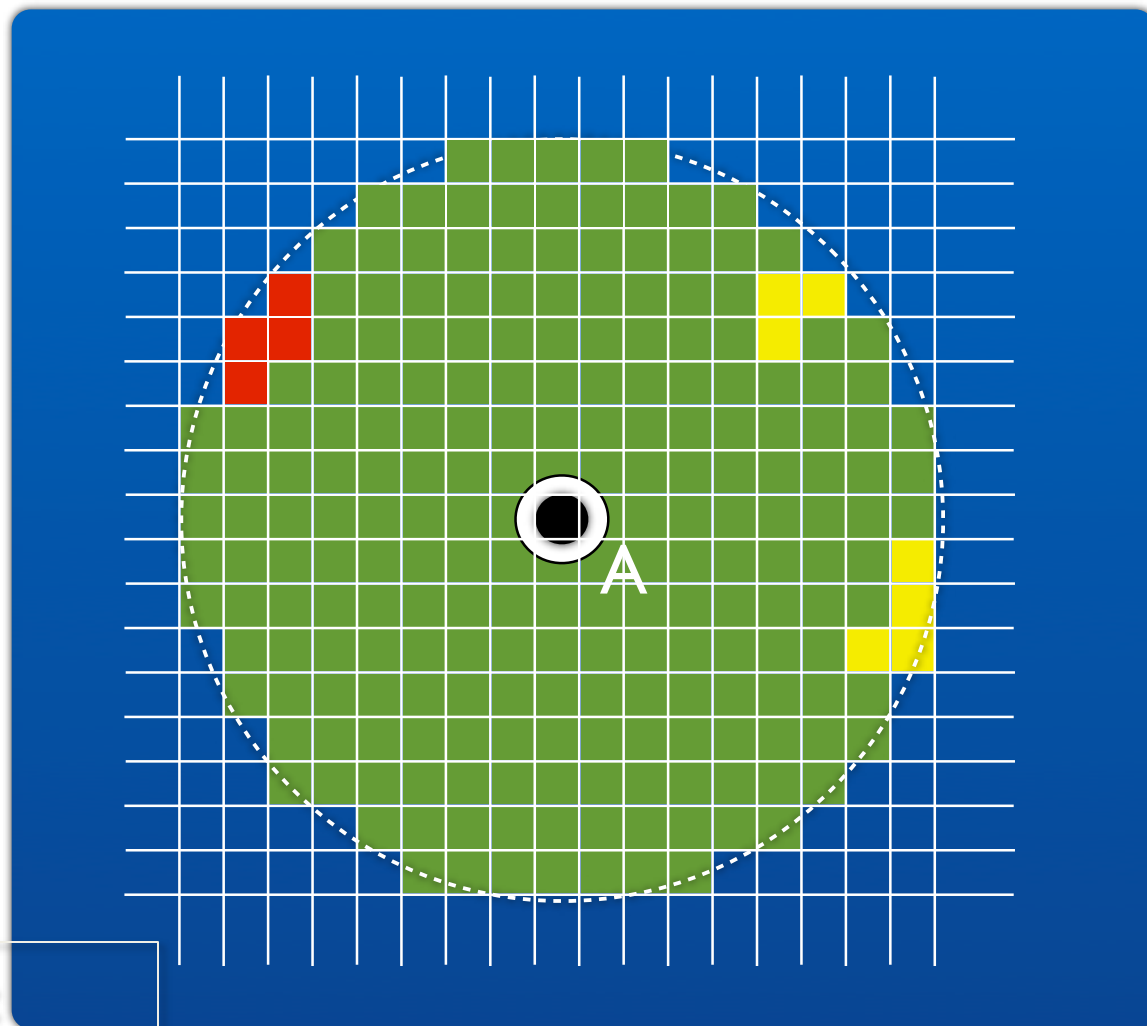
- “LONGLEY-RICE METHODOLOGY FOR EVALUATING TV COVERAGE AND INTERFERENCE”
  - DEVELOPED IN 1990S FOR THE TRANSITION FROM ANALOG TO DIGITAL
  - A METHODOLOGY FOR DETERMINING COVERAGE AREA AND POPULATION SERVED USING TWO PROPAGATION MODELS
- A FIVE-STEP PROCESS:
  1. ESTABLISH CONTOUR AS LIMIT OF SERVICE
  2. DIVIDE AREA WITHIN CONTOUR INTO SQUARE CELLS
  3. DETERMINE WHETHER COVERAGE EXISTS IN EACH CELL
  4. CHECK FOR INTERFERENCE IN EACH COVERAGE CELL
  5. SUM POPULATION OF ALL CELLS HAVING INTERFERENCE-FREE COVERAGE





## WHAT IS OET-69 ?

INTERFERING  
STATION



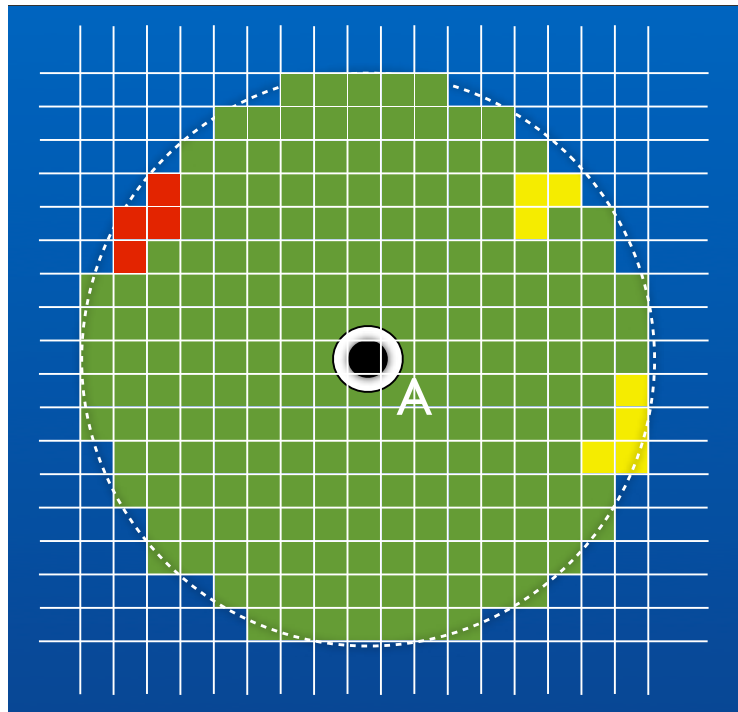
GREEN = COVERAGE

YELLOW = NO COVERAGE

RED = INTERFERENCE



## POSSIBLE DEFINITIONS FOR COVERAGE AREA AND POPULATION SERVED



FOR PURPOSES OF SATISFYING THIS  
MANDATE, WE PROPOSED TO INTERPRET:  
COVERAGE AREA = NOISE LIMITED  
CONTOUR W/O REGARD TO  
INTERFERENCE  
(THE AREA INSIDE THE CIRCLE)

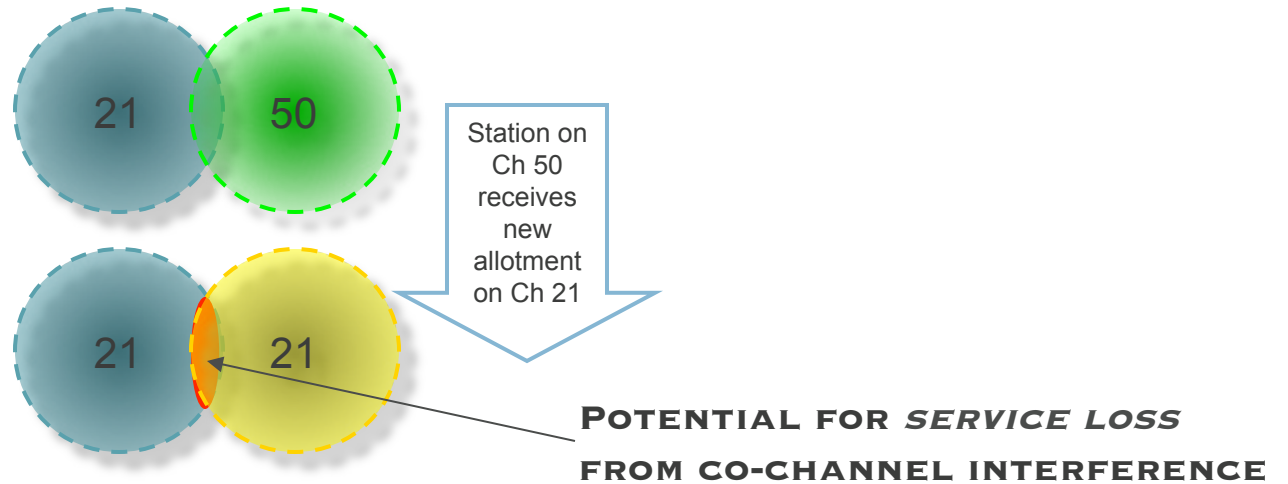
POPULATION SERVED = WHO RECEIVES  
SIGNAL WITHIN THE COVERAGE AREA,  
EXCLUDING STATION INTERFERENCE AND  
TERRAIN OBSTRUCTIONS  
(THE GREEN AREA)



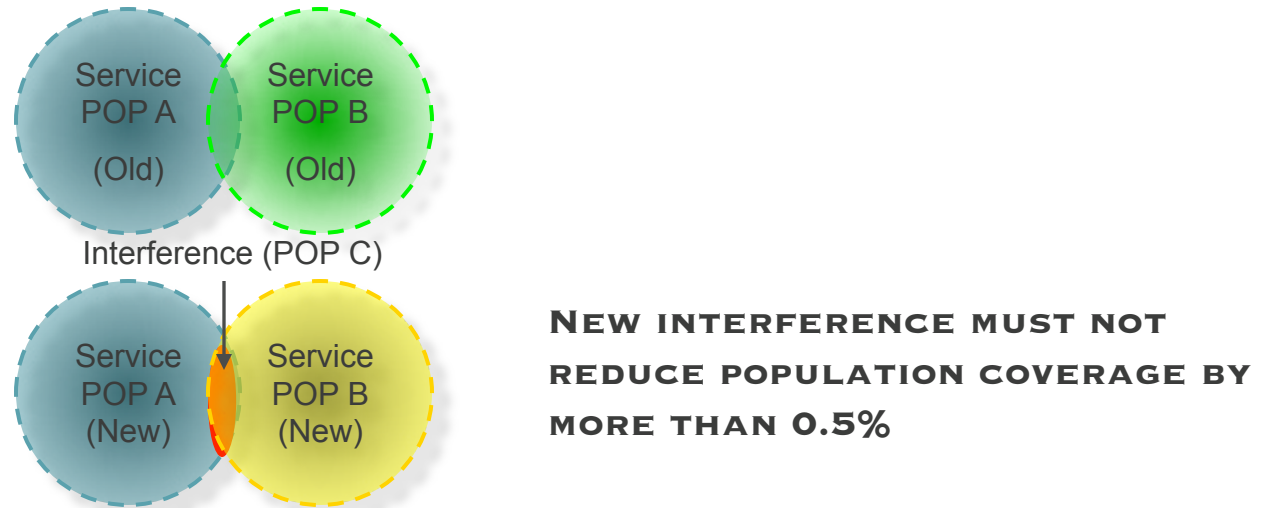


## EFFECT OF REPACKING

### CHANNEL CHANGE



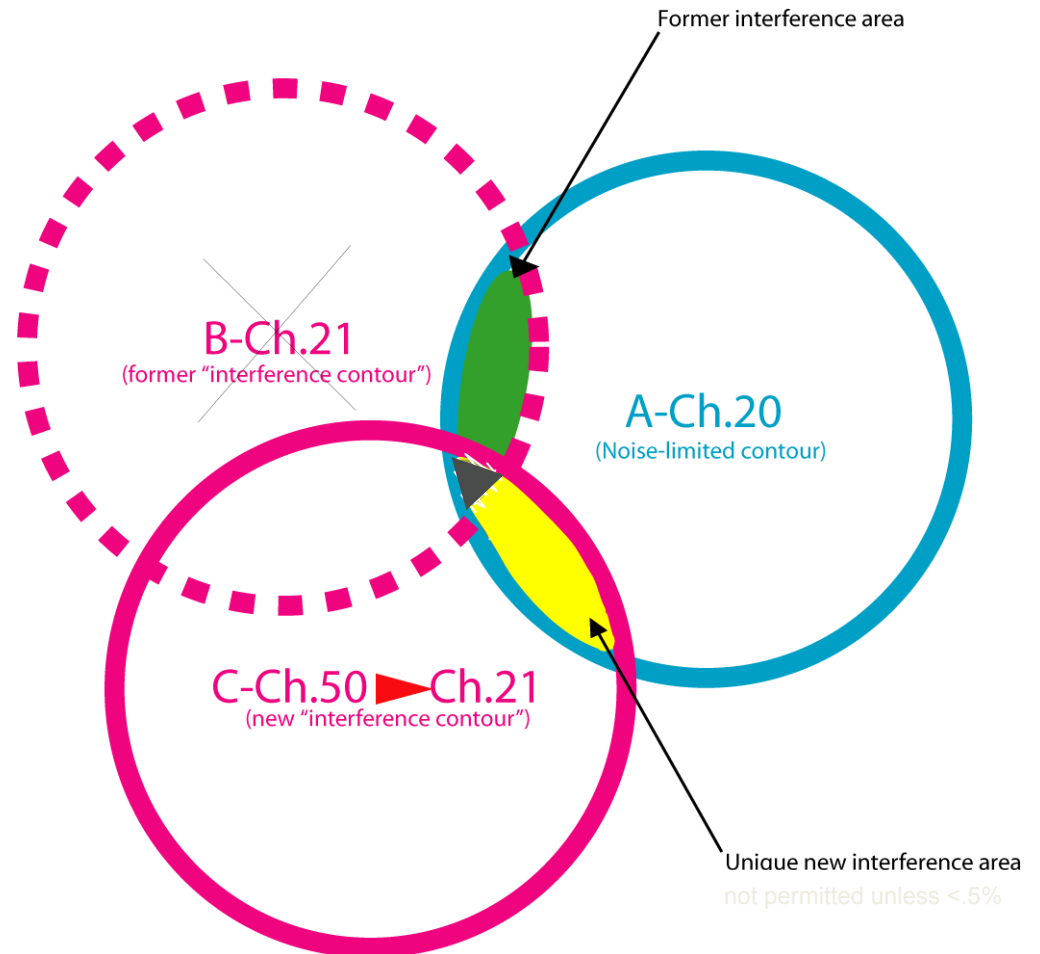
### SERVICE IMPAIRMENTS





## “FIXED” OPTION TO PRESERVE POPULATION SERVED

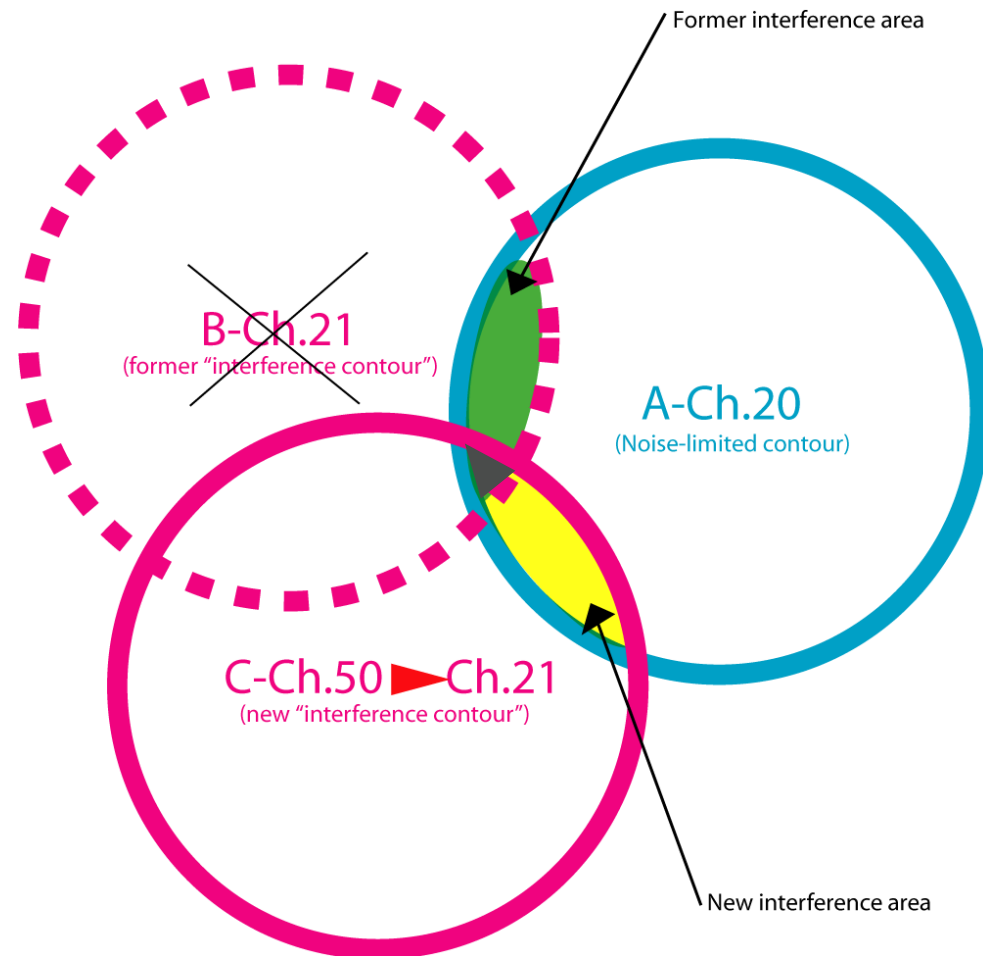
- REPACK CAN ONLY “REPLACE” POPULATION INTERFERENCE EXISTING AS OF 2/22/12
- POTENTIAL TO GAIN NEW VIEWERS (GREEN)
- CHANNEL ASSIGNMENT NOT PERMITTED IF POPULATION SERVED LOSS EXCEEDS 0.5% (YELLOW)
- PREDICTED AREAS OF NO CHANGE (BLACK)





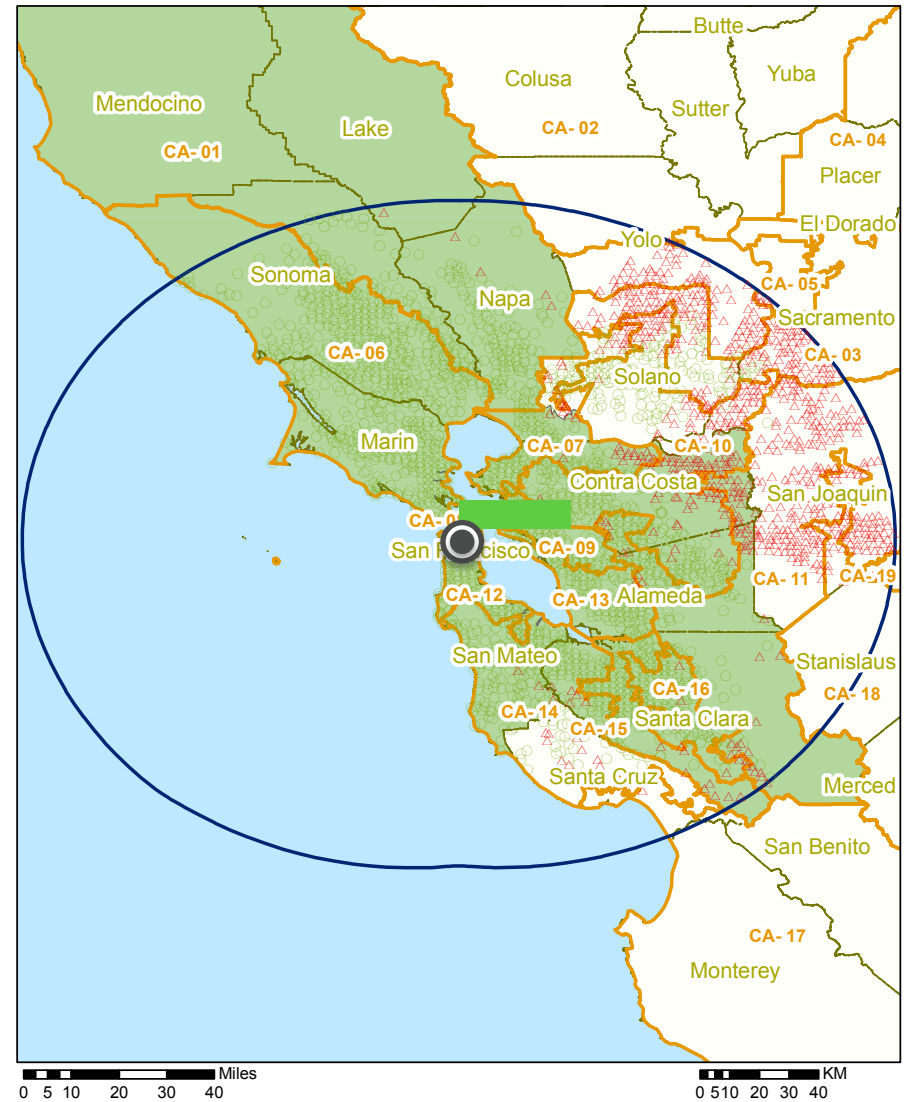
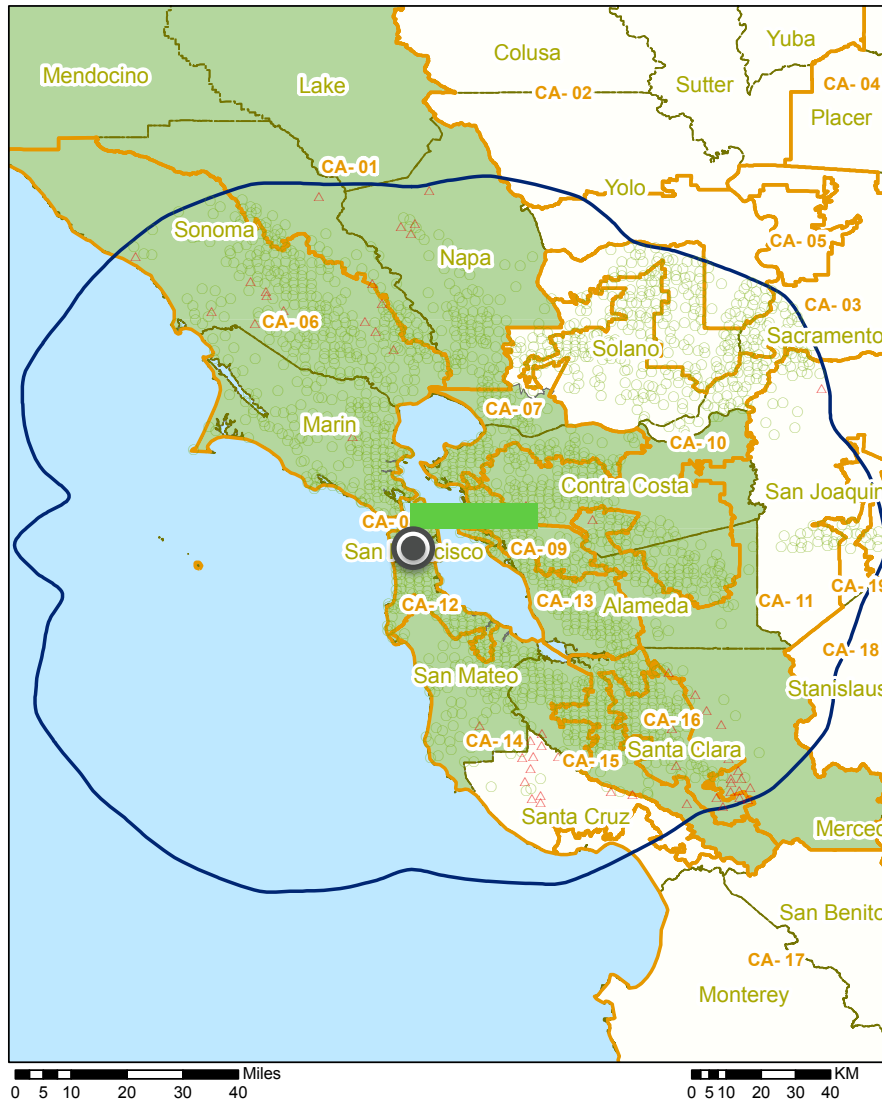
## “FLEXIBLE” OPTION TO PRESERVE POPULATION SERVED

- REPACK CAN'T RESULT IN MORE TOTAL POPULATION INTERFERENCE THAN THE STATION HAD AS OF 2/22/12
- TOTAL POPULATION INTERFERENCE WOULD STAY THE SAME, BUT AREA(S) OF NEW INTERFERENCE COULD OCCUR ELSEWHERE IN COVERAGE AREA
- POSSIBLE POPULATION GAINS AND/OR INCREASE IN POPULATION SERVED (GREEN)
- POSSIBLE POPULATION LOSS (YELLOW)
- POSSIBLE AREAS OF NO CHANGE (BLACK)





## LOCAL EXAMPLE: BOTH STATIONS HAVE 6.5M I-F COVERAGE





## COMPUTATIONAL CHALLENGES

- RESULTS OF OET-69 CALCULATIONS CAN DETERMINE WHICH STATIONS CAN BE PERMITTED ON CO- AND ADJACENT-CHANNELS TO OTHER STATIONS
- FOR EXAMPLE, IF THE “FIXED” INTERFERENCE OPTION IS ADOPTED, EXISTING AREAS OF POPULATION INTERFERENCE CANNOT BE MOVED
  - REQUIRES BOOKKEEPING OF INTERFERENCE ON A CELL-BY-CELL BASIS – MILLIONS OF CELLS
  - BECAUSE MANY TV STATIONS ARE COLLOCATED (*E.G.*, SUTRO TOWER), THERE MAY BE MANY PERMUTATIONS THAT CREATE THE SAME GEOGRAPHIC INTERFERENCE
- PERFORMING A FULL-BLOWN OET-69 ANALYSIS AT EVERY STEP OF THE AUCTION MAY BE UNWORKABLE
- WE BELIEVE WE CAN STREAMLINE THIS PROCESS BY USING OET 69 TO ESTABLISH A TRUTH TABLE OF CHANNEL COMBINATIONS WOULD BE PERMISSIBLE, BASED ON WHATEVER INTERFERENCE CRITERIA THAT ARE ESTABLISHED.



## SIMPLIFYING USING A TRUTH TABLE

- CELL-BY-CELL OET-69 RESULTS ARE VERY DETAILED
  - TYPICAL FULL-POWER STATION COVERS ABOUT 7,400 CELLS
  - CELLS HAVING ZERO POPULATION CAN BE IGNORED
  - CELLS HAVING “D” BELOW A DEFINED THRESHOLD CAN BE IGNORED
- NOT ALL CELLS NEED BE CONSIDERED
- THE DETAILED OET-69 RESULTS FOR RELEVANT CELLS CAN BE BE SIMPLIFIED INTO AN INDEXED TRUTH TABLE, WHERE FOR EACH CELL:
  - $$\left[ \begin{array}{l} \text{INTERFERENCE-FREE COVERAGE} = 1 \\ \text{INTERFERENCE} = 0 \end{array} \right]$$
  - AN INDEX WILL BE NEEDED TO PROVIDE LOCATION AND POPULATION REFERENCES



## **ADDITIONAL CONSTRAINTS**

- **LAND MOBILE OPERATIONS ON UHF TELEVISION CHANNELS**
- **TELEVISION STATIONS IN CANADA AND MEXICO NEAR THE COMMON BORDER**
- **RADIO ASTRONOMY AND MEDICAL TELEMETRY**
- **OFFSHORE RADIOTELEPHONE SERVICE**



**QUESTIONS?**

